

CLAIMS

What is claimed is:

1 1. A waste gas treatment system, comprising:

2 a thermal oxidizer, for oxidizing selected gaseous
3 species of a waste gas stream at an elevated
4 temperature;

5 a cyclone scrubber coupled to an outlet of the thermal
6 oxidizer, for removing at least a portion of the
7 particulate matter and acid gases of the waste gas
8 stream, the cyclone scrubber including a tube through
9 which the waste gas stream flows and means for fully
10 wetting the inner surface of the tube;

11 a packed bed scrubber containing a packing material and
12 coupled to an outlet of the cyclone scrubber, for
13 removing remaining particulates and acid gases of the
14 waste gas stream; and

15 a means for drawing the waste gas stream through and from
16 the waste gas treatment system.

1 2. The waste gas treatment system of Claim 1, wherein the gas
2 drawing means comprises a blower coupled to an outlet of the
3 condenser.

4 3. The waste gas treatment system of Claim 1, further comprising
5 a condenser coupled to an outlet of the packed bed scrubber,
6 for reducing a water vapor concentration of the waste gas
7 stream.

1 4. The waste gas treatment system of Claim 1, wherein the thermal
2 oxidizer further comprises an oxidizing gas inlet for
3 injecting a pressurized oxidizing gas stream into the waste
4 gas stream for creating a turbulent mixture for greater
5 combustion efficiency.

- 1 5. The waste gas treatment system of Claim 1, wherein the thermal
2 oxidizer further comprises a tube through which the waste gas
3 stream passes.
- 1 6. The waste gas treatment system of Claim 5, further comprising
2 a means to heat the surface of the tube for oxidation of
3 selected gaseous species of the waste gas stream.
- 1 7. The waste gas treatment system of Claim 1, wherein the inside
2 of the thermal oxidizer is lined with Nickel.
- 1 8. The waste gas treatment system of Claim 1, wherein the packed
2 column is a counter flow type packed column.
- 1 9. The waste gas treatment system of Claim 1, wherein the packed
2 column packing material is comprised of alumina ceramic.
- 1 10. The waste gas treatment system of Claim 1, wherein the packed
2 column packing material is comprised of stainless steel.
- 1 11. The waste gas treatment system of Claim 1, wherein the packed
2 column packing material is comprised of Teflon.
- 1 12. The waste gas treatment system of Claim 1, wherein the packed
2 column packing material is comprised of polypropylene.
- 1 13. The waste gas treatment system of Claim 1, wherein the water
2 supplied to the cyclone scrubber is recycled wastewater from
3 the packed column.

1 14. A method of abating toxic gases and particulate matter from a
2 waste gas stream in a treatment system, comprising the steps
3 of:

4 introducing the gas stream into the treatment system;
5 oxidizing selected gaseous species in the gas stream at
6 an elevated temperature to reduce the presence of
7 combustible substances in the gas;
8 scrubbing the gas stream to reduce the presence of
9 particulate matter and acid gases in the gas;
10 filtering the gas stream through a packed column to
11 reduce the presence of acid gas species in the gas;
12 and
13 expelling the gas stream to ambient and drawing the gas
14 stream through the treatment system.

1 15. The method of Claim 14, further comprising the step of
2 condensing the gas stream to reduce the moisture content in
3 the gas before the gas is expelled to ambient.

1 16. An apparatus for removing particulate matter and acid gases
2 from a waste gas stream while inhibiting clogging and
3 corrosion of a waste gas treatment system, the apparatus
4 comprising:

5 a system inlet for the introduction of the waste gas
6 stream;
7 a cooling section coupled to the system inlet, the
8 cooling system including
9 a heat exchange means for cooling the waste gas and
10 a wetting means for reducing clogging and corrosion
11 caused by particulate matter in the waste gas;
12 a scrubbing section coupled to the cooling section, for
13 removing at least a portion of the particulate matter
14 and acid gases of the waste gas stream; and
15 an outlet for discharging the treated waste gas.

1 17. The apparatus of Claim 16, wherein the wetting means of the
2 cooling section comprises:
3 an outer tube and an inner tube, wherein
4 the inner tube has a diameter less than that of the
5 outer tube, and
6 the inner tube is located inside of and
7 substantially concentric with the outer tube,
8 forming an annulus between the inside surface of
9 the outer tube and the outside surface of the
10 inner tube; and
11 one or more cyclonic water inlet jets extending into the
12 annulus through the outer tube, providing a cyclonic
13 flow of water in the annulus around the inner tube,
14 wherein the cyclonic water flow fills the annulus and
15 cascades over the top of the inner tube wetting the
16 inside and outside surfaces of the inner tube and the
17 inside surface of the outer tube, wherein the wet
18 surfaces of the inner and outer tubes inhibit
19 adherence of the particulate matter in the waste gas
20 to the inside surfaces of the tubes.

1 18. The apparatus of Claim 16, wherein the heat exchange means of
2 the cooling section comprises:

3 an outer tube and an inner tube, wherein
4 the inner tube has a diameter less than that of the
5 outer tube, and
6 the inner tube is located inside of and
7 substantially concentric with the outer tube,
8 forming an annulus between the inside surface of
9 the outer tube and the outside surface of the
10 inner tube; and

11 one or more cyclonic water inlet jets extending into the
12 annulus through the outer tube, providing a cyclonic
13 flow of water in the annulus around the inner tube,
14 wherein the cyclonic water flow fills the annulus and
15 cascades over the top of the inner tube, wetting the
16 inside and outside surfaces of the inner tube and the
17 inside surface of the outer tube, wherein a heat
18 exchange occurs between the waste gas stream and the
19 water to reduce the temperature of the waste gas
20 stream as it flows through the cooling section.

1 19. The apparatus of Claim 16, wherein the scrubbing section
2 further comprises:

3 one or more water atomizers extending into the scrubbing
4 section for

5 establishing forced contact between pressurized
6 water droplets and particulate matter in the
7 waste stream, causing the particulates to adhere
8 to the water, forming a water/particulate
9 mixture, and

10 causing absorption of at least a portion of the acid
11 gases of the waste gas stream into the water; and
12 a means for expulsion of the water/particulate mixture
13 from the scrubbing section.

1 20. The apparatus of Claim 19, wherein the water supplied to the
2 water atomizers is fresh water.

1 21. The apparatus of Claim 19 wherein the water supplied to the
2 water atomizers is recycled wastewater.

1 22. A method of inhibiting clogging and corrosion of components
2 in a waste gas treatment system, comprising the steps of:

3 providing an inner tube through which a waste gas stream
4 flows;

5 providing an outer tube, wherein

6 the outer tube has a diameter greater than that of
7 the inner tube, and

8 the inner tube is located inside of and

9 substantially concentric with the outer tube,

10 forming an annulus between the inside surface of

11 the outer tube and the outside surface of the

12 inner tube;

13 injecting a cyclonic water flow into the annulus, causing

14 a wetting of the inside surface of the outer tube and

15 the outside surface of the inner tube; and

16 filling the annulus until the water level cascades over

17 the top of the inner tube, forming a film of water on

18 the inside surface of the inner tube, inhibiting the

19 adhesion of particulate matter from the waste gas

20 stream to the inside surface of the inner tube,

21 preventing clogging and corrosion of the tube.